626
P191c
no. 33

ALTGELD HALL STACKS

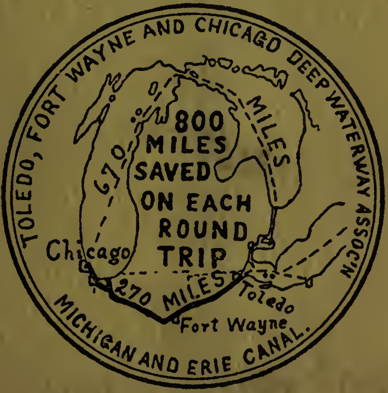
THE FORT WAYNE ROUTE

THE MICHIGAN AND ERIE SHIP CANAL

OR

Toledo, Fort Wayne and Chicago Deep Waterway

A proposed canal in aid of national commerce:
A link that makes the distance by water from
Chicago to New York the same
as the distance by rail


TOLEDO, FORT WAYNE AND CHICAGO DEEP WATERWAY ASSOC'N
670
MILES
800 MILES SAVED ON EACH ROUND TRIP
Chicago
270 MILES
Toledo
Fort Wayne
MICHIGAN AND ERIE CANAL.

Published by the
Toledo, Fort Wayne and Chicago Deep Waterway
Association of
FORT WAYNE, INDIANA

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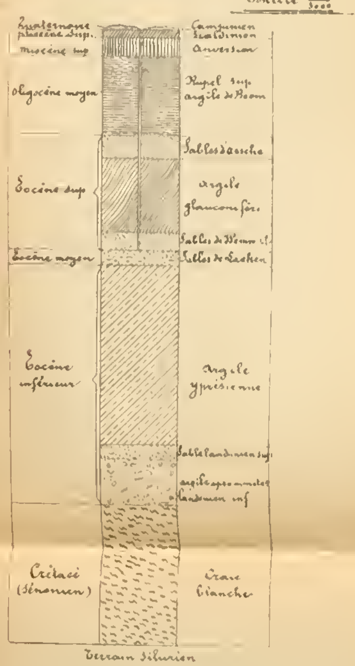
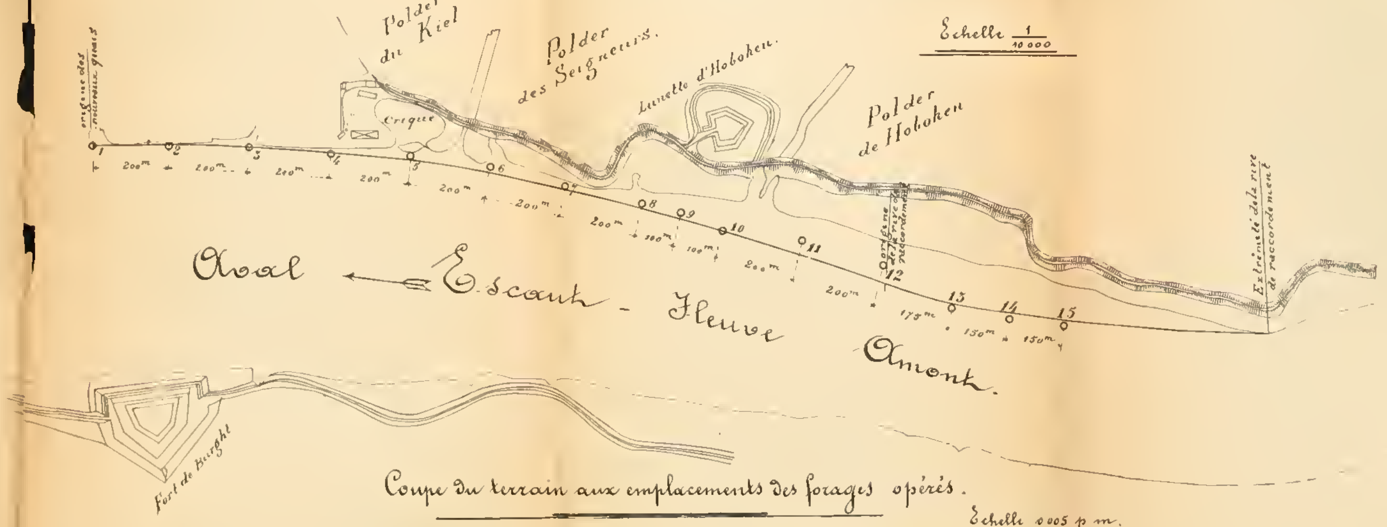
Série des couches géologiques en dessous De la Ville d'Anvers.

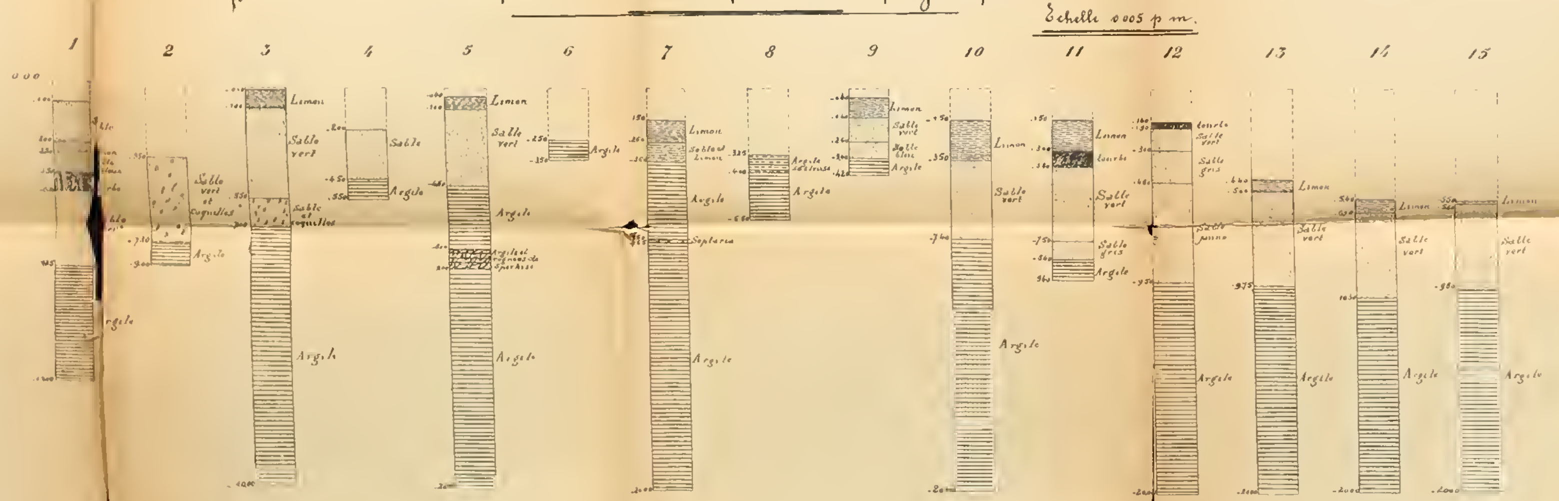


Extrait de l'ouvrage : "Anvers à travers les âges géologiques" Le sol d'Anvers et l'Escaut par le baron O. van Ertborn et Paul Cogels.

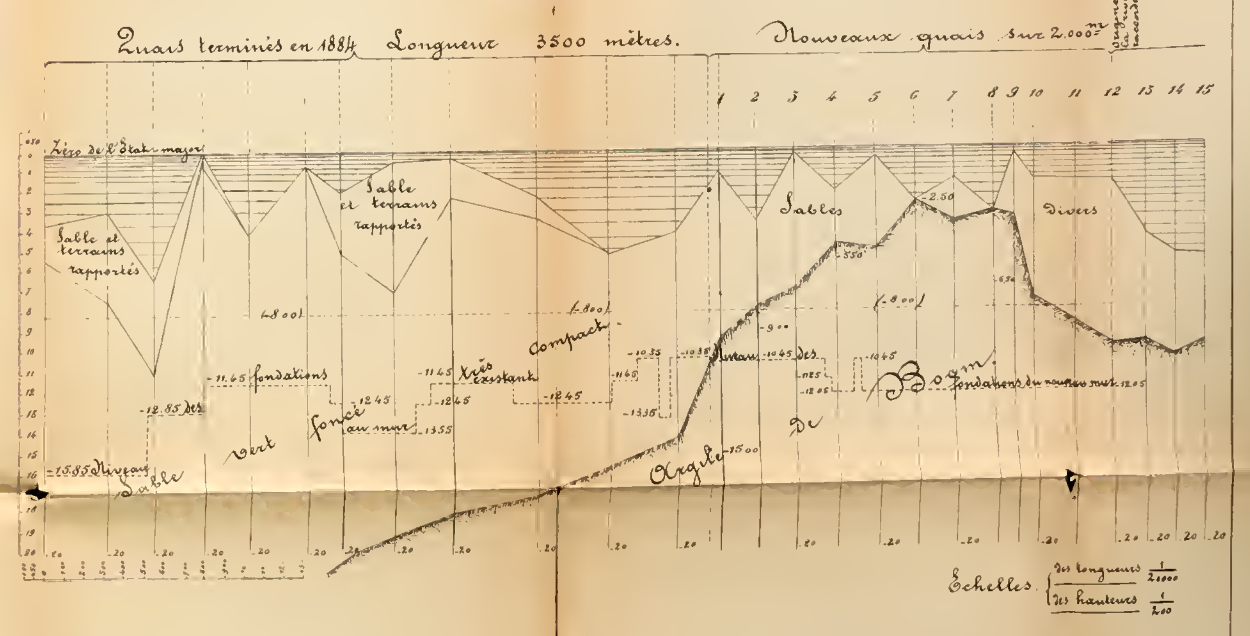
Plan indiquant l'emplacement des forages.



Coupe du terrain aux emplacements des forages opérés.



Coupe en long des terrains le long de la rive droite de l'Escaut entre l'écluse du Kattendyk et l'extrémité amont du mur projeté.



ALTGELD HALL STACKS

The Michigan & Erie Canal
OR
Toledo, Fort Wayne & Chicago Deep Waterway

BY

FRANK B. TAYLOR

THE NEED OF INLAND WATERWAYS

A few years ago it required the vision of a prophet to see that railroad transportation in the United States was nearing the time when it would become inadequate for the needs of commerce and that a great system of inland waterways must soon be built. Now, every intelligent man who will take the trouble to inform himself by a study of the statistics of commerce and of railroad and waterway transportation must see, not merely the possible benefits of inland waterways, but that they are greatly needed at the present time and will become absolutely indispensable in the near future. It is this conviction in the minds of many wise and far-seeing men which has at last taken hold of the people and which is now moving the entire country to the advocacy of inland waterways.

It is not the object in this article to dwell at length upon the conditions of trade and transportation which show the need of inland waterways; that has been done by others. The great Deep Waterways Conventions and Congresses of recent years in the Mississippi valley, and the recent National Rivers and Harbors Congress in Washington are unmistakable expressions of the peoples' convictions and desires on this subject. The earnestness and enthusiasm of the people who attend these great conventions is beyond belief to any one who has not attended one of them. President Roosevelt's recent speeches at Memphis and Vicksburg and his recent messages to the national congress show the highest official appreciation of the country's needs along this line and give assurance of his earnest support for wisely planned measures of relief. But, lest some who read this may not realize the weighty reasons which are moving the people to demand inland waterways, a brief summary of general reasons is here given. If anyone doubts the wisdom of the present agitation, if he doubts the beneficial results which a general system of waterways will bring to all the people, let him consider the following facts:

1. That water transportation, even in relatively small craft, is much cheaper than transportation by rail, and that the cost grows less with increase in the size of the vessel—the larger the barge or ship the lower the cost. Transportation by water can be done with a profit at a cost only one-fifteenth to one-fourth, averaging about one-eighth, as much as by rail, the rate depending chiefly on the size of the boat. This applies especially to all bulky, low-value commodities, such as grain, coal, iron and steel, ice, ore, stone, brick, slate, sand, gravel, earth, cement, lime, lumber—in fact, to nearly all raw materials.

Col. John L. Vance, president of the Ohio River Improvement Association has said: "The heavier freight—coal, iron, steel, locomotives—are today carried on the Ohio and lower Mississippi for one-third of a mill per ton per mile—a less figure than on any other waterway in the world. This figure includes the return of empties, and leaves a handsome profit to the transportation lines." At this rate a ton is carried thirty miles for one cent or three thousand miles for one dollar. "As an example of cheap transportation on the Ohio and Mississippi the steamer Sprague may be cited. She has handled safely in one tow, 70,000 tons of freight in barges. With the most approved railway appliances in use at the present time this would require 2,333 cars—making a train fifteen miles long, not including the locomotives required to move these cars." These river rates are probably somewhat lower than can be expected generally on canals. But even if they were several times more than here stated they would still be much lower than rates by rail. "A bale of cotton weighing 500 pounds goes by rail from Dallas, Texas, to Galveston, 300 miles, for three dollars, and from Lake Providence, La., to New Orleans by boat, the same distance, for fifty cents." "Coal from a certain mine is shipped to Pittsburg by boat on the Monongahela for three and one-half to four cents per ton; by rail, when navigation fails, for forty-four cents per ton. It is estimated that on the new Erie canal a dollar will carry a ton 1900 miles." "In the carriage of freight between Chicago and New York—by water to Buffalo and thence by rail to New York—the boats receive one-third and the cars two-thirds of the through rate, the boat mileage being double that of the car. In round numbers the railroad ton-mileage is about one-fourth that of the entire lake system, while the freight charge is more than double, showing a ratio of over eight to one for general traffic in favor of water transportation."

"The average rate on all the railroads of the United States is 7.5 mills per ton per mile, while on the lakes the latest estimates put it as low as .85 mills per ton per mile. On the Ohio and lower Mississippi the rate is as low as .3 or some times .1 of a mill per ton per mile." For several years coal has been carried from Buffalo to Duluth, nearly 1,000 miles, for 30 cents per ton or at the rate of about .3 of a mill per ton per mile. Facts of this kind could be multiplied indefinitely.

2. That the countries of Europe—especially Holland, Belgium, France and Germany—have splendid inland waterways affording water transportation for every city and to every seaport. The prices of their raw material to themselves and of their manufactured products to the rest of the world are cheapened by low cost of transportation, and this is a factor of prime importance in the difficulties we encounter when we meet them in the world's markets.

Nearly all of the prosperous cities of our own country have more or less water transportation, and all of those which have not would be greatly benefited if they had. But in general our water transportation is poorly developed. The remedy is inland waterways, with one or two deep channels to the sea, the system which the people are now demanding.

3. That the building of waterways, if properly carried out, will afford opportunities for great development of waterpower. Canals will generally be constructed with reference to this factor as a secondary, but sometimes as a primary consideration. The running expenses and repairs of free canals can thus be paid and additional income secured from the water power.

4. That the canals and waterways being built and controlled either by the state or by the national government, or by these jointly, are made free to all and are not reserved for or controlled or managed by or in the interest of any trust or corporation or individual and that they will therefore tend to furnish a natural remedy for the regulation of railroad rates.

5. That the waterways will not work an injury to the railroads, but will, in fact, aid them, and greatly increase their earnings by operating to relieve them of the heavier, bulkier freights, leaving for the railroads chiefly the high class, faster freights and the express, mail and passenger business, all of which are willing to pay a higher rate for quicker transportation. Waterways stimulate manufactures by supplying cheaper fuel and raw materials, and this brings increase of population and increase in manufactured

products which go by rail, and in express, mail and passenger business. *Transportation facilities create traffic.*

6. And finally, just as the true character of the individual man may be measured by his unselfish acts rather than by his acts of self-interest, so, the state of civilization to which our country has attained may be measured by its acts of altruism, whether with reference to our near neighbors or to more distant peoples, or to our own unborn generations, rather than by our conquest of other peoples or a part or class of our own people for our immediate personal profit and advantage—in short, by our acts of foresight in providing for the welfare of all of our future citizens rather than by the present mad and reckless scramble for millions for ourselves. We ought to begin now to conserve our natural resources. We have had solemn warnings of their failure if the present wasteful methods of use continue. It is certain that within a century or two our natural fuel supplies will be nearing exhaustion. The locomotive engine is the largest and most wasteful of all consumers of coal. Waterways for carrying heavy and bulky freights would work an immense saving of fuel and postpone the evil day.

For these reasons and for many others that might be mentioned it is evident that the time has come to begin the building of inland waterways. But the building of them is at best a slow task, and even if begun today, by the time they are ready for use the need of them will be much greater than it is now.

THE LONG HAUL AND THE TWO MAIN WATER ROUTES.

The compelling fact underlying the whole of the present agitation for deep waterways to the sea and for systems of tributary inland waterways is the inevitable *long haul.* The long haul is a necessity growing out of geographical position and cannot be evaded. But it is now performed mainly in railroad cars and costs on the average about eight times as much as it would in boats on deep waterways.

The North Central Division of the United States, or in popular phrase, the Central or Middle West, comprises the twelve states of Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, North Dakota, South Dakota, Iowa, Nebraska, Kansas and Missouri. Their combined area is 753,550 square miles and they had in 1900 a population of over 26,000,000. They make one-fourth of the area of the United States and contain one-third of its population. Although endowed by nature with a soil of great fertility and with a moist, temperate climate highly favorable to agriculture, having been peopled by a mixture of the best nationalities of the earth, and having built up states and cities and a wonderful prosperity in agriculture, mining and manufactures, yet these states now find themselves fettered and enslaved in commerce, chiefly in consequence of their geographic position. They are practically debarred from foreign trade, because of the great cost and inadequacy of the only available means of transportation to and from the seaboard, and they are hampered almost as much and for the same reasons in their trade with our own seaboard population. For both of these markets they must pay the tax of the long haul mainly by rail. The commerce of the Middle West has grown by leaps and bounds and has far outstripped the coincident growth of railroad capacity. But even if the railroads had kept pace with commerce, they could not have relieved the present situation, to say nothing of the future, for the imperative need is for cheaper transportation than the railroads can possibly give. From the different parts of the Middle West it is 500 to 2,000 miles to the seaboard and the railroads, even at their best, cannot make this long haul at rates which can compete with water rates and enable this region to be an effective competitor in foreign and seaboard markets. The only remedy is water transportation in large bulk, which is the cheapest transportation in the world. But to realize the advantages of this requires deep waterways, at least for the main trunk lines to the seaboard. There are only two possible trunk line routes to the sea within the boundaries of the United States, one south down the Mississippi River and the other east through the Great Lakes, the Erie Canal and the Hudson River. The only salvation of the Middle West industrially and commercially is in making both of these into deep waterways, or, if possible, into ship canals.

These two trunk lines are of the first importance—should be considered first and built first. They are both used today for commerce, but in only a very limited and ineffective way, and are wholly inadequate to the needs of the country. In their present condition neither of them is capable of carrying barges or ships of such size as are indispensable for the long haul at the cheapest possible rates.

It is true that we have already that most magnificent of waterways, the Great Lakes system, with its tonnage greater than that of any other waterway in the world, the broad ocean alone excepted. But the lakes are not now adequately connected with the seaboard—not by a ship canal or really deep waterway; nor are they connected with the Mississippi River, and the Mississippi itself, although capable of a great commerce as it is, is nevertheless not now fitted to carry the commerce that it ought and can surely be made to carry.

The state of New York is now at work enlarging the Erie canal between the Hudson river near Troy and the Great Lakes at Buffalo, but when completed this canal will be only a moderately deep waterway. According to the design the new canal is intended to be a barge canal rather than a ship canal, its depth being only twelve feet. This limitation of depth for the new canal seems very unfortunate, for there ought to be at the earliest possible day at least *one real ship canal* within the boundaries of the United States, connecting the Great Lakes eastward with the ocean. The Canadians are giving their new St. Lawrence-to-Ontario ship canals a depth of twenty-one feet and purpose twenty-four feet for their Ottawa canal. It seems certain that the Erie canal will have to be again deepened in the near future. Indeed, a strong movement has lately been set on foot in New York to have it made twenty-one feet deep now.

The prospects for the early completion of the Lakes-to-the-Gulf great waterway seem particularly bright at the present time. Indeed, if Congress recognizes the needs of commerce and the earnest desire of the people, this work will be in progress within a year. The whole route has already been surveyed, and even now as a result of experimental dredging by the Mississippi River Commission during the low water of the fall of 1907, it is practically certain that a fourteen feet channel can be maintained at all times of the year from Cairo to the Gulf. This depth was maintained experimentally during the recent low water on three bars without serious difficulty. The route of the connecting canal up the Illinois and Des Plaines rivers to join the Chicago drainage canal and Lake Michigan has already been surveyed and ought soon to be under construction.

THE PROPOSED MICHIGAN AND ERIE CANAL AN INDISPENSABLE PART OF THE GREAT EAST-AND-WEST MAIN WATER ROUTE.

The great east-and-west trunk line or long-haul waterway from Chicago to the sea may be said to be composed of four divisions: (1) the Hudson river, (2) the Erie or Erie and Hudson canal, (3) Lake Erie and (4) either the lake route through Mackinac Straits now in use or else the proposed Michigan and Erie canal, which would cut off the long northward detour and would run from Lake Erie to Chicago by a nearly direct route. This canal would shorten the distance about 400 miles and would make the long-haul, all-water route from Chicago to the seaboard of substantially the same length as the present all-rail route. To have a deep waterway or ship canal from Chicago to New York as short as the direct all-rail route is the best result that can be reached. No better solution of the Middle West-to-seaboard transportation problem is attainable. It represents the maximum possible efficiency of water transportation—the cheapest possible water rates for the unavoidable long haul. Water and rail transportation would then be set up against each other in flat competition with no advantage of distance to either one. The only advantages either would have over the other would be such as are inherent in the instrument. Cars would be better for some things, boats for others; and equality of distances would tend to make the adaptation of trade to them more perfect and thus give the best possible service to the public.

When the Erie canal in New York has been completed as a ship canal, the great east-and-west deep water route as it has been thought of up to the present time will be finished and ready for use. But it will be far from perfect even then; for it will still be about 400 miles longer than the all-rail route, and water rates for transportation will therefore fail to touch the bottom values which ought to be reached.

This extra 400 miles is 43 miles farther than from Chicago to Cleveland by rail; nearly as far as from Baltimore to Boston and lacks only 42 miles of being as far as from New York to Buffalo by the New York Central Railroad. This much distance would be saved every trip. Not until a shorter route is made available will east-and-west long-haul rates come down to bed rock value which they ought to reach and which the people are entitled to have. Too much stress can not be laid upon the fact that even after the Erie canal is completed every ship and barge that sails from Chicago to New York by way of the Straits of Mackinac will have to travel about 400 miles farther than it would if a deep waterway were built from Chicago to Toledo across northern Indiana and Ohio. And further, in going back to Chicago every returning ship will have to repeat the same 400 miles detour through the northern straits. In short, every boat plying between Chicago or any point west of Chicago and Toledo or any point east of Toledo will have to travel 800 miles farther than necessary in every round trip until the proposed Michigan and Erie canal is built. This is 37 miles farther than from Fort Wayne to New York by the Pennsylvania railroad, or exactly as far as from Chicago to Baltimore. This distance of 800 miles would be saved on every round trip. Indeed, every ship that travels the northern route today has to make this long detour, and every ship in the past has had to do it. The value of the coal alone that has been consumed in traveling this extra 400 miles is probably more than enough to build the canal, to say nothing of the insurance premiums and losses paid and the value of the lives and property lost in wrecks that would have been avoided.

Between Chicago and New York the saving of distance by the proposed canal amounts to two-sevenths or a little more than one-quarter of the whole distance; between Chicago and Buffalo

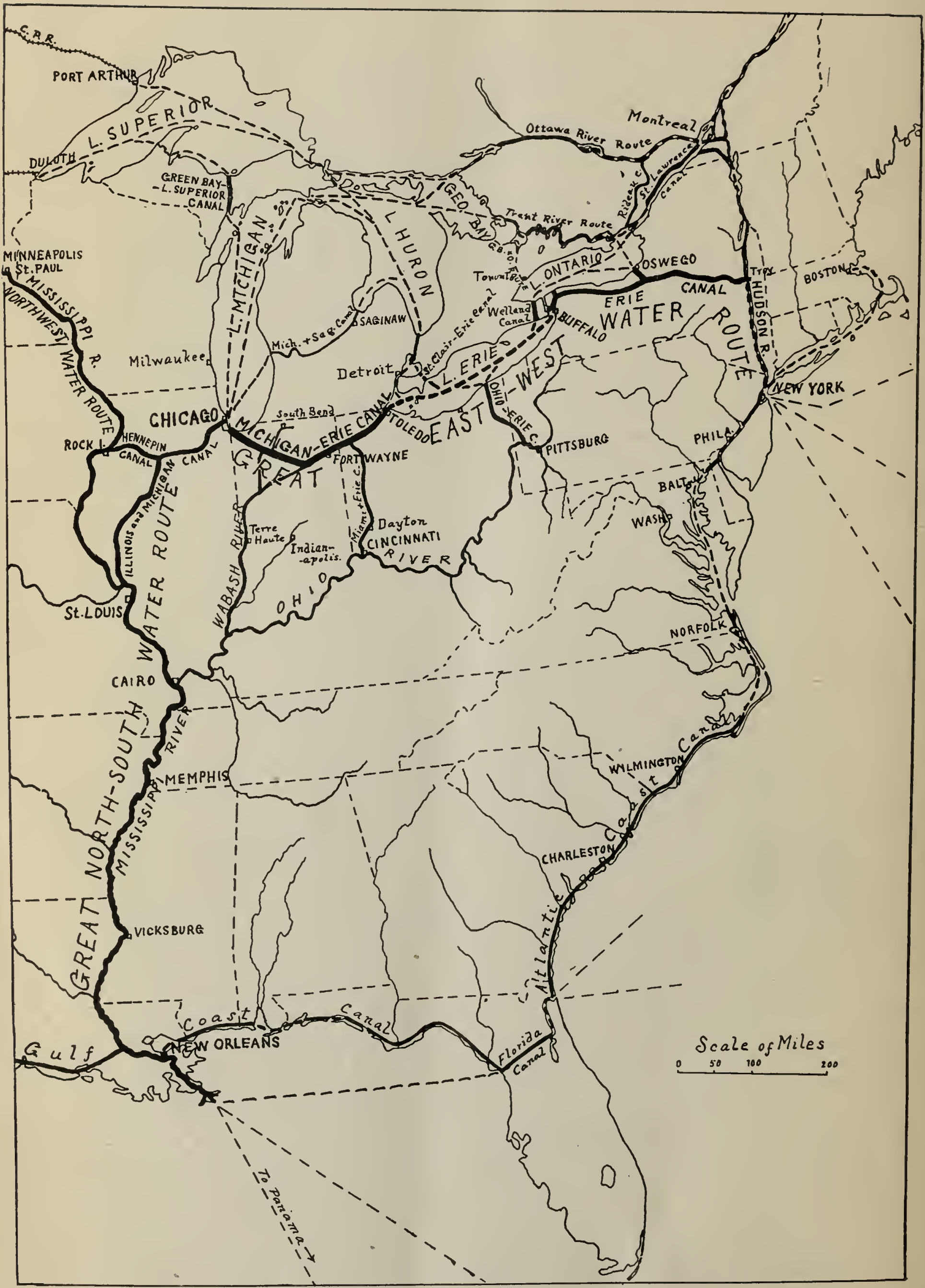


Figure 1.—Sketch showing place of the proposed canal as a link in the east and west main water route

it is nearly one-half; between Chicago and Cleveland or Detroit more than one half, and between Chicago and Toledo nearly two-thirds. Can there be any doubt of the value of this canal, if its construction is feasible and within bearable limits of expense?

The accompanying sketch map, Figure 1, shows the place of the proposed canal as a link in the great east-and-west water route. Its advantages as a cut-off or short route from Chicago to Lake Erie will be easily noted, and also the fact that it makes a nearly straight line from Chicago to Troy, N. Y., and thus gives an all-water route to New York City, which is practically of the same length as the all-rail route—roughly, 1,000 miles, instead of 1,400 miles as the all-water route is now.

This canal is really an indispensable part of the east-and-west main water route to the sea and will surely be built sooner or later. Indeed, after the Erie canal has been made into a ship canal, it cannot be long deferred. Its service to commerce will be like that of the Baltic canal in Germany; like that of the proposed Sandwich canal which will cut off Cape Cod and like the proposed Florida canal. It will cut off the southern peninsula of Michigan, save the long northward detour and give a route which will be closed by ice only half as long.

THE PHYSICAL FEATURES OF THE COUNTRY TRAVERSED BY THE PROPOSED CANAL.

In northern Indiana, northwestern Ohio and Southern Michigan the whole country is covered with a heavy deposit of glacial drift. Solid rock lies beneath, but is nearly everywhere buried to a depth of from 100 to 300 feet. The bed rock is exposed to view in only a few places and in very small areas. A glacial moraine, or broad ridge of clay, sand and stones known as the Erie-Saginaw moraine runs from a point about ten miles northwest of Logansport, Indiana, towards the northeast, passing out at the northeast corner of the state, and thence in the same direction to Lapeer County, in Michigan, fifty miles north of Detroit. Its top is ten to twenty miles wide and its surface is hilly and uneven. Its hollows hold hundreds of small lakes and ponds which vary in extent from seven to eight square miles, with occasional depths of 80 to 100 feet, down to little ponds a few square rods in area and dry in times of drouth. Besides the lakes, there are many stream valleys, marshes and prairies which are extremely favorable for the formation of reservoirs. The great ridge has an altitude of 1,000 to 1,200 feet above sea level in southern Michigan and 900 to more than 1,000 feet in northeastern Indiana. It forms the watershed between Lake Erie on the east and Lake Michigan and drainage to the Mississippi on the west. During the Ice Age the basin of Lake Erie, including the Maumee Valley, was occupied by a great lake which had its outlet at Fort Wayne, Indiana, through a river a mile or more wide which flowed southwest to the Wabash at Huntington and thence to the Mississippi. The divide on which the waters now part, going east to Lake Erie and west to the Mississippi, is in the channel of this old outlet just west of the City of Fort Wayne and has an altitude of 760 feet above the sea. At Fort Wayne another moraine or ridge of glacial clay runs southeast along the north side of the St. Mary's river, curving gradually to the east after entering Ohio. From about 800 feet altitude in the south part of the City of Fort Wayne, it rises gradually to over 900 feet in western Ohio and to still greater altitudes farther east. Thus the lowest gap in the rim of the basin of Lake Erie on its west and south sides is at Fort Wayne. The lowest one in Ohio is about 910 feet, and in Indiana northwest of Fort Wayne there is one at about 860 feet, but none lower. Northeastward into Michigan there are none below about 950 feet. West of the great moraine in Indiana there is a gently sloping, sandy plain descending northwesterly to the broad, swampy Kankakee valley. Then another moraine or belt of clay seven or eight miles wide separates the Kankakee valley from Lake Michigan. This is called the Valparaiso moraine. Its crest is rather narrow in the northwestern counties of Indiana and it has an altitude of less than 800 feet in the part west of Valparaiso.

REASONS FOR SELECTING THE FORT WAYNE AND ROCHESTER ROUTE BETWEEN TOLEDO AND CHICAGO.

Lake Erie is 573 feet and Lake Michigan 581 feet above sea level. The lowest passage over the drift ridge between them is through the old outlet channel at Fort Wayne at 760 feet. Indians used this route before the coming of the white man, and the engineers of 1826 used it for the old Wabash and Erie canal. But that canal was designed to connect Lake Erie with the Ohio and Mississippi rivers. It was never built to Lake Michigan, or to Chicago, although a line going northward from Delphi was surveyed in 1831. Many years ago a canal was talked of to connect Toledo and Michigan City by a nearly direct route. This was in 1880 or '81—about the same time the Wabash and Erie canal was re-surveyed by the late William S. Goshorn from Toledo to Lafayette for a projected enlargement which was never carried out. About 1895 Dr. William T. Harris, then of Defiance, Ohio, now of Chicago, began promoting the Toledo-Michigan City project. The route suggested by him was up the

Maumee to the state line east of Fort Wayne, and thence west to Cherubusco through the valley of Cedar Creek, or else up to Fort Wayne and northwest from Fort Wayne to the same point, and thence past Goshen, Elkhart and South Bend to Michigan City. As an alternative to this and affording a shorter route, a line was suggested leaving the Maumee at Defiance and going northwest over the high moraine to Pigeon Creek and down this to Elkhart, South Bend and Michigan City. The summit level on the Cherubusco route could hardly be less than 850 feet above sea level, or 100 feet higher than the summit level available at Fort Wayne. On the Pigeon Creek route it would have to be 50 to 100 feet higher than on the Cherubusco line. Either of these routes is feasible for a small canal of the old type; but, as will be pointed out below, they are both impossible for a deep waterway or a ship canal.

At a meeting of citizens in the City of Fort Wayne November 16, 1907, called to start a movement for a canal from Toledo to Fort Wayne, a plan was suggested for a deep waterway or ship canal from Toledo to Chicago, passing through Fort Wayne and Rochester, Indiana. The route proposed is as follows: From Toledo up the Maumee river to Fort Wayne; thence through the old outlet channel to Huntington, and along the higher ground on the north side of the Wabash river to the city of Wabash; thence northwestward in a nearly direct line, crossing Eel river a little below Roann, and continuing in the same line past Rochester and down the Tippecanoe river to a point south of Lake Maxinkuckee; thence on the same line across the Kankakee river at the lower end of English lake, passing north of Kouts station; thence from a point about six miles northwest of Kouts northward to a point two miles east of Sedley, and thence, as may seem best, either directly north to Lake Michigan at a point eight miles northeast of Hobart, or continuing northwest from Sedley, to Wolf lake and South Chicago. On this route it is designed that the summit level shall run from Fort Wayne, or some point a few miles east of Fort Wayne, to a point on the Tippecanoe river south of Lake Maxinkuckee and that the canal in this interval shall be level and without locks. This would give a summit level about one hundred miles long at an altitude somewhere near 750 feet above the sea, or 177 feet above Lake Erie. With locks of twenty feet lift, sixteen or eighteen locks would serve the whole canal.

The selection of this route is based on the following principles, which seem to be essential elements in the building of a deep waterway or ship canal under the conditions which exist in the region between Lake Erie and Lake Michigan.

1. The canal must have the largest possible supply of water at its summit level—at least enough to operate one of its locks one hundred times a day, and as much more as is possible. This is the first and indispensable requisite.

2. The canal should have the lowest possible summit level in order (a) that the building of locks, which is very expensive, shall be reduced to a minimum in the original cost of construction, and (b) that the number of locks shall be the fewest possible, because boats lose time in passing through them and because locks add materially to the cost of both operation and maintenance.

3. The canal should follow the shortest line on which its construction is feasible *and on which it can have at the same time the fewest locks and obtain the greatest possible water supply for its summit level.*

A comparison of the Fort Wayne-Rochester route with any other that has been suggested, or that can be suggested, shows that this route would have a lower, longer summit level and hence fewer locks, and would secure a very much larger water supply for its summit than can be obtained on any other route. All the routes suggested appear to be feasible from the point of view of engineering. But in the matter of water supply at summit level, which, after feasibility of construction, is the all-important thing for a deep waterway or ship canal, the several routes are widely different. The Pigeon Creek and Cherubusco routes would have their summits on the top of the high drift ridge, where the possible water supply is necessarily limited. The summit level would have to be short—certainly not more than fifteen or twenty miles long—on both of these lines, and the area of country which could by the utmost effort be made tributary to the summit level would be relatively small. On either of these routes the area could hardly exceed 700 or 800 square miles. There would be no rivers to draw upon and only a few very small creeks. Almost the entire reliance would have to be upon the existing lakes, of which there are a considerable number, and upon reservoirs artifically constructed. But these lakes and reserviors would be not merely a supplementary supply to use in the dry months to augment temporarily a regular supply from other sources, as would be their use on the Fort Wayne-Rochester route; they would be the sole reliance and would have to be drawn upon throughout the whole season of canal navigation. The drainage areas available for the different summit levels are shown in the second map, Figure 2. These routes are both excellent lines for canals of small size, say of six or seven feet depth, and one or both of them will no doubt be utilized some time in this way. But

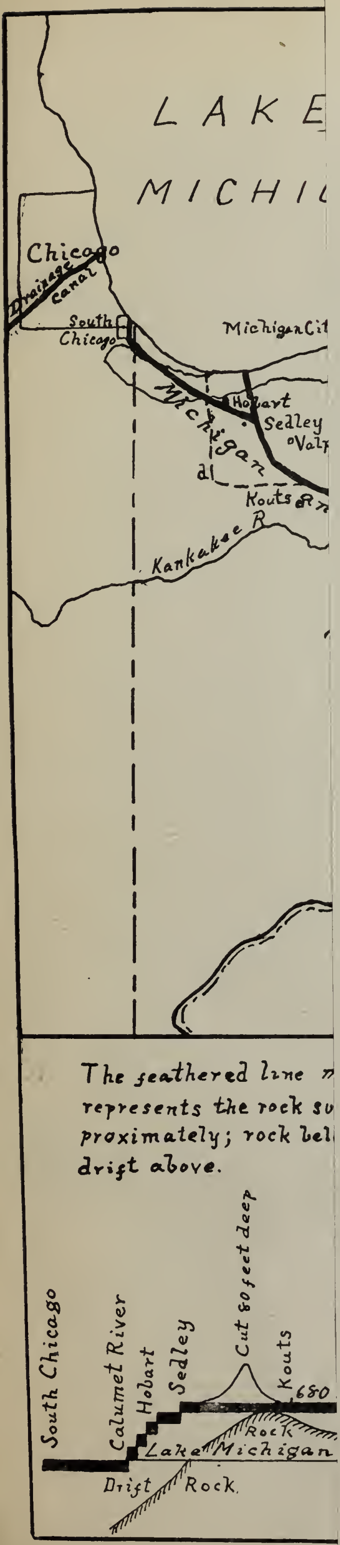


FIGURE 2. Map sl
of proposed canal showing

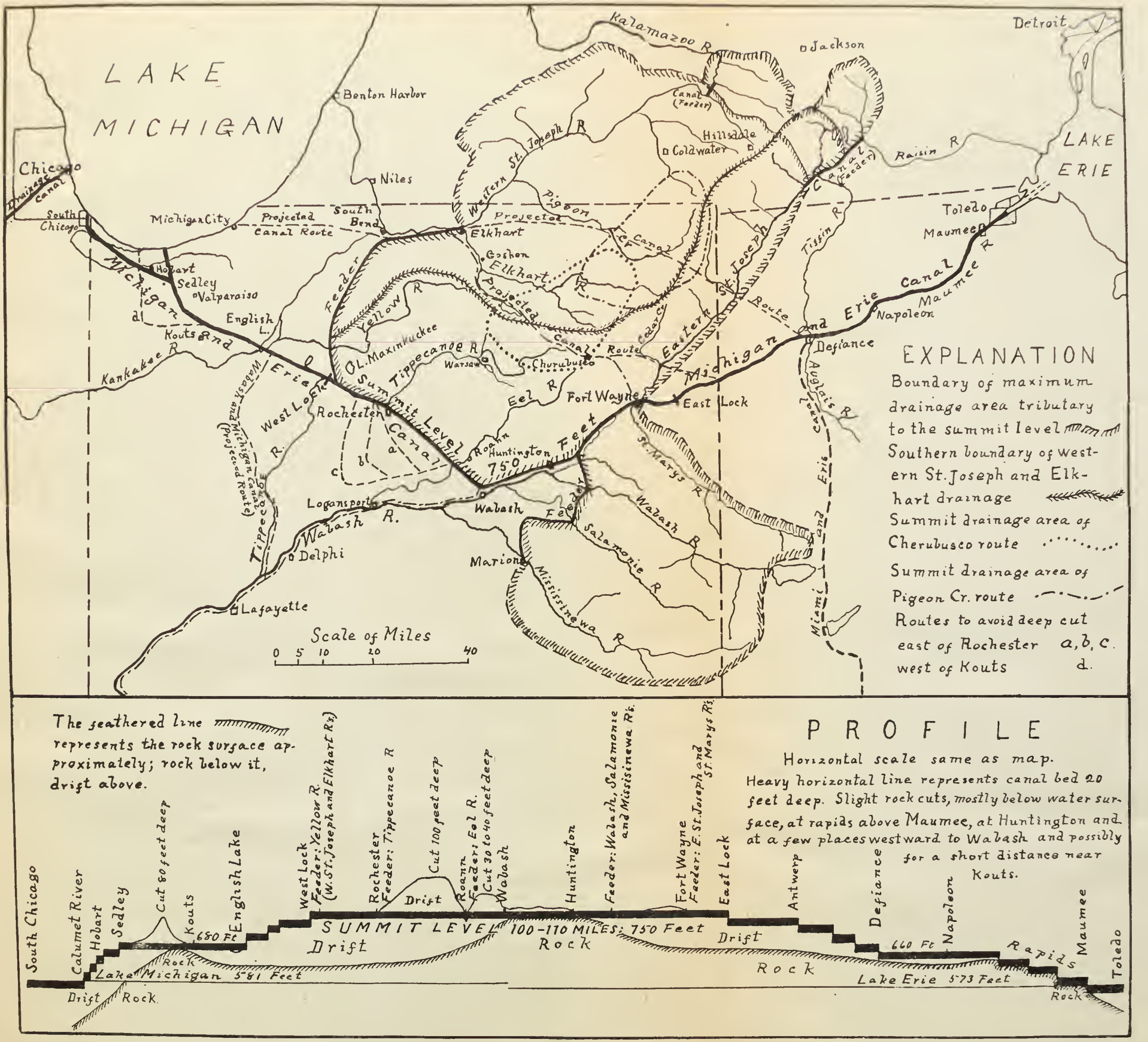


FIGURE 2. Map showing route of proposed canal and other projected routes with maximum drainage area tributary to each. Below is the profile of proposed canal showing long summit level, locks and location of deep cuts.

they are manifestly not available for a great, deep waterway or ship canal.

If a deep waterway between Lake Erie and Lake Michigan is to serve the purpose for which it is intended, it must have water enough to operate its locks a great many times each day, for if it were in any sense a success, it would be a very busy canal. When this canal is planned officially, it ought to be with a distinct view to future possible needs; that is, it ought to be laid out on that route which will command or make available the maximum possible water supply for its summit level. It seems improbable that a fourteen feet canal could have water enough at its summit level on either the Cherubusco or Pigeon Creek routes; but granting for the moment that it would, the developments of the near future will surely show the folly of such a choice. When the Erie canal in New York is made into a ship canal, twenty-one or perhaps twenty-four feet deep, as it surely will be in the near future, (The Chicago Drainage Canal is now a splendid ship canal, twenty-four feet deep and 162 feet wide in its rock sections) it will at once become desirable, if not imperative, not merely to have the proposed canal, but to have it of the same capacity as those east and west of it. In that event it would be simply impossible to get water enough for a twenty-one or twenty-four feet canal on the Cherubusco or the Pigeon Creek routes.

Finally, when a canal has been brought from Toledo up to the summit at Fort Wayne, what is the use of running it up over a hill 100 feet higher than Fort Wayne, building ten or twelve more locks than necessary and causing every boat to lose the time required to operate them forever after? Why go over a hill, when a way is open to go around it on a level line and with immense advantages for the summit level water supply?

Two other routes have been suggested in times past. One is over the hill in southern Michigan, going up either the Raisin, or the Huron river to Jackson and then down either the Kalamazoo or Grand rivers to Lake Michigan. These are feasible for small canals, but are open to the same objections as the Pigeon creek and Cherubusco routes—too high and not enough water supply. The Huron river is larger than the rivers on the other high level routes and the accessible lakes are larger and more numerous, but the summit level would have to be up to nearly 1,000 feet above the sea.

The other way is along the line of the old Wabash and Erie canal from Fort Wayne down the Wabash river to Delphi, and thence north to Lake Michigan. But on this route the canal would descend to the Wabash river at Huntington and the summit level at Fort Wayne would be short, and would be fed only by the St. Joseph and St. Mary's rivers at Fort Wayne, with possibly the Wabash and Salamonie rivers added at some point above Huntington. Of these streams the St. Joseph is the best, but is not large. The others are not so good as the St. Joseph. It is doubtful whether a fourteen feet canal could be operated successfully from these streams in a dry autumn. But again, having brought the canal up to the Fort Wayne divide, what is the use of dropping it down into the Wabash valley and losing the advantage of the large summit level water supply, if it is possible to run the canal along on a level and secure this supply? These different routes are shown on the second map, Figure 2.

FEASIBILITY OF CONSTRUCTION ON THE PROPOSED ROUTE.

This is not the place to describe at length the details of the topography and geology of the country along the proposed route, but it may be said briefly that the features are known in considerable detail and that the construction of a deep waterway or ship canal on this route is entirely feasible. Indeed, the whole route, with the exception of two or three comparatively short intervals, is very favorable, and the difficulties encountered in these intervals can be avoided, if necessary, without sacrificing the special advantages which this route offers. For the very valuable detailed information available along this route the writer is indebted to Mr. Frank Leverett, of Ann Arbor, Michigan, before whom the project was laid soon after the meeting in Fort Wayne and who, as a geologist of the United States Geological Survey, has studied the topography and drift of northern Indiana and Ohio in detail, having examined every township of the region on foot and collected records of all the deeper wells, showing the depth and character of the drift. Mr. Leverett expressed himself as confident not only of the feasibility of the route for the construction of the proposed canal, but expressed equal confidence in the availibility of a sufficient water supply for the summit level to make it entirely adequate to meet the needs of commerce.

Mr. Leverett recently laid the project of this canal before Mr. Lyman E. Cooley, the well known engineer of the Chicago Drainage and Ship Canal and member of the U. S. Deep Waterways Commission. Mr. Cooley expressed himself as much pleased with the project. In his letter to Mr. Leverett he says:

"I think your solution of the route from Toledo to Lake Michigan by Fort Wayne is the most important yet presented.

The water supply is the important consideration, and your proposition gives better command of this than any heretofore suggested."

The writer afterwards had an interview with Mr. Cooley in his office in Chicago and is indebted to him for a number of valuable suggestions.

Mr. Cooley strongly advises canalizing the Maumee river up to Fort Wayne rather than the construction of an independent canal. He says it will be cheaper and better in every way. Fifteen or twenty miles of the Tippecanoe river can also be canalized below Rochester. Mr. Cooley said he was particularly impressed by the lowness of the proposed summit level, by its great length and by the large water supply which it makes available.

The physical features of the route may be briefly summarized as follows: Rock cutting would be necessary in slight measure in two and possibly three stretches of the canal, but there would be no deep cutting. For about fifteen miles above Maumee, Ohio, the river has rapids over limestone ledges. Rock cutting here would be confined almost wholly to shallow cutting in the bed of the canal, an ascent of about 63 feet being made in this interval. Rock would be encountered again at Huntington, Indiana, and more or less of it from there to Wabash. But here again little if any of the cutting would be deeper than the bed of the canal. There is also a possibility of encountering a little rock cutting near Kouts in the northwestern part of the state, but this would be short and shallow and might possibly be avoided altogether. None of these rock cuts are formidable from the point of view of canal construction, and it is doubtful whether all of them together will supply as much stone as will be needed for bank protection.

The only sections of the canal that present anything difficult in construction are two localities in which the most desirable route for the canal would require rather deep cutting. Both of these, however, would be entirely in clay drift with no rock cutting whatever and the work is simply a straightaway problem for steam shovels. The most formidable cut would be through the big drift ridge between Roann and Rochester. Here for a distance of five or six miles the ridge has an altitude of about 850 feet, requiring a cut of about 100 feet deep through this part. For six or eight miles more the cutting would be 50 feet or less in depth, about two-thirds of it less than 25 feet.

This is what would be required if the canal is built on the shortest possible route from Fort Wayne to Chicago. But it can be conducted around this hill, if desired, by a longer route so as to reduce the depth and length of the deep cut or even to avoid deep cutting entirely. This could be accomplished by turning west on the north side of Eel river. Near Denver, six miles west, the canal could be turned north so as to pass down the valley of Mud Creek to the Tippecanoe river. On this line the hundred foot cut would be reduced to a mile or two and most of the remainder would be under fifty feet. Or, going a little farther west, the canal could be turned northwest at Hoover to a point about three miles east of Lucerne and thence north. By this route there would be very little cutting more than fifty feet and most of it twenty-five feet or less. If this route proved too formidable, the canal could be carried still farther west to a point about eight miles northwest of Logansport where it could turn northward to the Tippecanoe without any deep cut whatever, the level of the land being nearly the same as that of the canal. These three alternative routes are shown on the map Figure 2, in broken lines as a, b, and c, respectively. As is often done in great works of this kind, the making of the direct-line deep cut might be deferred in the first construction, to be completed at a later time. These alternative routes make the summit level somewhat longer, but do not sacrifice the large water supply.

Next to this the most important cutting would be through the clay hill between Kouts and Sedley. This would be seven or eight miles long, but would be more than fifty feet deep only for a mile or two with a maximum of about eighty feet. Here again, however, if deemed necessary, the cutting can be entirely avoided by turning the canal west just north of Kouts to Hebron and thence north past Leroy and down Deep river. (Shown by broken line d on map, Figure 2.) The divide in the valley which cuts the ridge at Leroy has an altitude of 686 feet and the projected level of the canal through this section is 680 feet.

There would also be cutting in the drift 30 or 40 feet deep for perhaps five or six miles between Wabash and Roann and occasional short cuttings between Huntington and Wabash, but not of formidable depth.

The deep cuts required if the canal were built as projected on the shortest possible line would not be justified in the construction of a small canal, but they are entirely within the measure of surmountable difficulties and bearable and justifiable expense for a deep waterway or ship canal constructed by the national government, or by the national government and the local states combined;—a canal serviceable chiefly as a highway of national commerce rather than for local purposes, and presenting possibilities of incalculable advantage for military purposes in times of war. It seems certain that the difficulties of construction along the projected line, including the deep cuts, are not such as would lead the national government to deviate from the direct course laid out. Even if, as might seem best, the canal be given a depth of only fourteen feet at first, its course ought to be laid out with a view to possible future enlargement to a ship canal twenty-one or twenty-four feet deep, or equal to the deepest canal elsewhere connected with the Great Lakes. Its permanent works—its locks and terminal facilities in particular—ought to be built in the first place for a ship canal, and should therefore be of large size and so arranged as to be easily made double in the future at each locality. The prism of the canal (its depth and width) between the locks could readily be enlarged at a later time if found necessary. But the rebuilding and enlargement of locks would be troublesome and very expensive.

THE LONG SUMMIT LEVEL AND THE LARGE WATER SUPPLY MADE AVAILABLE BY IT.

There are many advantages in the very long summit level proposed for this canal. Its length of one hundred miles or more makes it possible to bring in more streams and a greater quantity of water at the summit than could possibly be obtained on any other summit level in the region traversed. The long summit level would touch or cross the St. Mary's and St. Joseph rivers at Fort Wayne, the Eel river below Roann, and the Tippecanoe river below Rochester. It would also pass within comparatively easy reach of the Yellow river near Lake Maxinkuckee and the Wabash and Salamonie rivers near Huntington. At Mr. Leverett's request Mr. M. O. Leighton, chief of the hydrographic division of the U. S. Geological Survey, furnished the following official data on the quantity of water available for the summit level of the proposed canal from the first five rivers named.

Michigan and Erie Canal.
(Via Fort Wayne and Rochester.)

Water supply required for fifty complete lockages (100 single lockages) per day for summit level, elevation 750 feet above sea level, length about 100 miles. (Depth of canal supposed to be fourteen feet or deeper).

Locks 348 x 69 x 16 feet, water contents..	384,192 cubic feet
100 lockages per day, in round numbers..	38,400,000 cubic feet.
Add 10 per cent for leakage, in round numbers	3,800,000 cubic feet.
Total	42,200,000 cubic feet.

Equivalent to 490 second feet (cubic feet per second).

Drainage Areas Tributary to Summit Level:

Upper Eel river above Laketon	480 square miles.
Tippecanoe river above Fulton-Pulaski county line	760 square miles.
Yellow river above Marshall-Stark county line	260 square miles.
Total	1,500 square miles.

These are the figures furnished by Mr. Leighton. But by placing the dam on Eel river at Roann a further area of about 100 square miles may be added to this figure for Eel river. This would make the total 1,600 square miles. Mr. Leighton states further that the mean flow for the lowest months in each year for four years at Delphi, Knox and Logansport is .29 second feet per square mile. This multiplied by 1,600 gives 464 second feet. The mean flow for the lowest month of the St. Mary's river at Fort Wayne is 40 second feet. The mean flow for the lowest month of St. Joseph river at Fort Wayne is 150 second feet. This gives a total available low water flow of 654 second feet. Subtracting 490 second feet, which is needed for fifty complete lockages per day, plus 10 per cent for leakage, there remains an excess of 164 second feet *without resorting to storage.*

Such a showing as this from only the convenient streams and without any resort to storage or the bringing in of water from more distant rivers gives sure ground for faith in the future of this canal as a deep waterway, especially when it is realized how much and how easily this can be increased. Later, Mr. Leighton furnished additional data on the amount of water that could be obtained through a feeder from the St. Joseph and Elkhart rivers at Elkhart by the way of South Bend to the summit level near Lake Maxinkuckee. The drainage area of Elkhart river above Elkhart is 700 square miles; that of the St. Joseph river above Elkhart is 2160 square miles, making a total of 2,860 square miles. The lowest month at Elkhart between 1901 and 1906 was September, 1906, at which time the flow was 1,565 second feet. This is two and one-third times as much as the amount obtained from the combined five streams mentioned above. Adding this to the 654 second feet from the other streams, the total is 2,219 second feet. This is enough for fifty complete lockages per day with locks twice as long, twice as wide and twice as deep as those given by Mr. Leighton, and still leave 259 second feet in excess. Such a lock would be 696 feet long, 138 feet wide and 32 feet deep. It would use four times as much water at each operation as the one described by Mr. Leighton, or 247,400 cubic feet more water than the Poe lock at Sault Ste. Marie. But this is both wider and deeper than would be needed for a ship canal of the most liberal capacity according to present ideas. The locks of the Panama canal are designed to be only 110 feet wide. By cutting off some of the width and depth of the enlarged lock described above and adding an equivalent volume to its length the lock could be made equal to the largest locks now in use, or considerably larger if need be. It could easily be made of the same dimensions as the Poe lock, the largest of the locks at Sault Ste. Marie, which is 800 feet long, 100 feet wide and 21 feet deep on the mitre sill. The large, new Canadian lock is 900 feet long, 60 feet wide and 21 feet deep. The U. S. engineers are said to be now planning to build a new lock at Sault Ste. Marie 1,300 ft. long, 80 ft. wide and 24 ft. deep.

There are a few other streams that can be brought into the summit level without much difficulty. The Wabash river could be received at a point above Huntington and the Salamonie could be conducted over to the Wabash quite easily and brought in with the latter stream. The Mississnewa could also be made to contribute, but not so easily. At the time of this writing no official figures are at hand to show the amount of water which these streams would yield. But on a conservative estimate by comparison of the drainage areas with that of the St. Marys river it seems safe to say that the Wabash river near Markle would yield about 40 second feet; the Salamonie near Warren 30 second feet and the Mississinewa below Marion 45 second feet, making a total for the three streams of 115 second feet. This added to the previous amount would make 2,334 second feet.

Something more could also be added to the water supply from rivers by diverting the head waters of certain streams in southern Michigan into one or the other of the two St. Joseph rivers. At a point about fifteen miles southeast of Hillsdale, Mich., where the eastern St. Joseph turns from southeast to southwest, there is an old abandoned river bed coming from the Tiffin river, about three miles northeast. It would be a very easy thing to divert the upper part of the Tiffin to the St. Joseph through this old channel, and by carrying a feeder canal northeast along the side of the eastern slope for twenty to twenty-five miles farther, several of the upper branches of the Raisin river could also be captured. The drainage area thus divertable to Fort Wayne would be about 300 square miles. In the same way some of the upper branches of the Kalamazoo river could be diverted to the western St. Joseph so as to enter the feeder at South Bend. This would amount to about 200 square miles. The 500 square miles of these two areas would yield about 145 second feet, making the total from rivers 2479 second feet. Besides these it is possible that one or two of the head branches of Grand river near Jackson could be brought in. Something would also be received from several smaller streams, like the tributaries of Little river, east of Huntington, and others to the west. If a summit level feeder were built to South Bend it would capture a number of small streams. These put together would certainly bring the possible grand total from streams up to 2,500 second feet. All this is from streams alone and represents approximately the amount possible to derive from the available rivers at low stage.

WATER RESOURCES AVAILABLE BY STORAGE.

The possible resources for water supply from storage in lakes and reservoirs are not included in the above estimates. Ordinary maps on a large scale show 50 to 100 lakes in northeastern Indiana. Prof. Charles R. Dryer, who surveyed six counties in the northeastern corner of the state for the State geologist in 1886, says that, counting large and small, there are probably a thousand lakes, and there are probably half or two-thirds as many more in southern Michigan which could be drawn upon through the rivers mentioned above. The water that might be stored in these lakes if developed to a maximum cannot be stated, but would certainly be very large—surely enough to double or more than double the supply available from the streams alone. When to this is added the further possibility of making almost as many artificial reservoirs in this area as there are existing lakes, there can be no longer any doubt whatever that there is available, if fully called into use, water enough for any magnitude of ship canal that can now be foreseen as a possibility, and for any degree of activity which seems likely. The region of the small lakes is a hilly, morainic country with many valleys and ravines and is very favorable to the making of artificial lakes. For storage purposes the existing lakes would probably not be drained off below their present levels, but would be raised a few feet by dams and then drained down only to their present levels. According to Mr. Cooley, three to four per cent. of a given area made into lakes or reservoirs will equalize the flow of the streams from that area.

The foregoing is simply a picture of what is possible in the way of a maximum water supply for the long summit level of the proposed canal. The facts stated ought to dispel forever all doubts as to the sufficiency of the available supply. Of course, in practice nothing like all this possible supply is likely to be drawn upon at once. Much of it may be better employed for other purposes, at least for the present. The amount diverted to the canal at any given time would probably not be very greatly in excess of that which would be needed to operate the canal, though some considerable excess is highly desirable for the sake of the water power that can be developed from it. If the canal is built at first with a depth of fourteen feet, the water for it would probably be drawn from the first five rivers named with the Wabash and Salamonie added, and these would probably be supplemented by a moderate development of storage as a reserve resource against any possible shortage from the rivers. The long summit level would itself have an enormous reservoir effect. It would be like a large lake. If feeders from South Bend and Elkhart and from the Wabash and Salamonie rivers were run at summit level the total length of the whole level would be close to 200 miles with corresponding extension of reservoir capacity. This is one of the most desirable of all things for any great canal.

WATER POWER.

One of the most important benefits to be derived from a canal like that proposed is. the development of water power. In Illinois where the supply of water is practically unlimited and the canal of large capacity, it is designed to develop a great amount of water power under the control of the state and to devote the proceeds to the cost of running and repairs and also to contribute much towards paying the original cost of construction. It is estimated that the water power there will be worth about $3,000,000 per year. The proposed Michigan and Erie canal would afford splendid facilities for developing water power at many places—particularly at Huntington, Wabash, South Bend, Elkhart, near Lake Michigan, and at Maumee, and the revenues thus derived should be applied to the expense of running and repairing the canal. The water powers already developed on the St. Joseph river near South Bend are not nearly so advantageously located as they would be if the water were drawn from this canal at South Bend at an altitude of 750 feet, (30 feet above the city). But while water power is a very important consideration in connection with canal building, it is not the most important. Measured by the rule of the greatest good to the greatest number it is certainly true that the water of the rivers and lakes confers a much greater benefit upon the people as a whole when used in aid of commerce in canals and canalized rivers than when used for the development of power by cities, corporations, or individuals.

A great saving in the amount of water required to operate locks can be made by any one of several methods; by hydraulic elevator or lift locks, like those on the Trent canal at Kirkfield and Peterborough, Ontario; by pneumatic lift rocks, or by side-chamber locks. Where the water supply is small, such locks make operation possible with only a small fraction of the water needed for the old method. When the water supply is adequate or large, the use of such locks would enable a much larger portion of the water to be used for the development of power.

CONNECTING CANALS.

When the Michigan and Erie canal is built it will be joined by several important connecting lines. Chief among these is the Miami and Erie canal which connects Cincinnati with Lake Erie at Toledo by way of Defiance. This canal is still in use and needs only moderate enlargement to do excellent service as a barge route to and from the middle section of the Ohio river. It would be particularly serviceable for bringing coal from West Virginia and Kentucky and southern Ohio to the North and Northwest, especially if the proposed ship canal gave it direct connection from Defiance to Chicago.

Another important connection would be the Wabash and Michigan canal connecting with the Wabash valley. It seems certain that the Wabash river will be canalized up to Lafayette or Wabash and then it would be an easy matter to carry a connecting line up the lower Tippecanoe and the Monon to join the Michigan and Erie canal. At Wabash the ship canal could easily be joined again from the Wabash river, so as to bring about in effect a restoration of the old Wabash and Erie canal, but with much greater capacity and utility. By canalizing White river and the Mississinewa, Indianapolis and other cities of central and southern Indiana can be brought into connection with the ship canal and receive the benefits of connection with lake navigation. These smaller branch canals, chiefly for local commerce, are proper objects for construction by the state rather than by the national government.

Another important branch line would be one extending north from near Lake Maxinkuckee to South Bend and Elkhart. This could be made at summit level throughout and without locks, thus adding largely to the reservoir capacity of the summit level. This branch even if built primarily as a feeder might as well be made navigable to serve the commerce of the cities mentioned, and also to give them the most effective development of water power.

The Wabash and Michigan canal is certain to be built in the near future, even if the main ship canal is not. When it is completed, the advantages of having a connecting line between it and the Miami and Erie canal at Defiance, substantially on the line here projected, will become so great that the people will soon regard it as a positive necessity. But instead of allowing construction to take this course and building the middle link afterwards, making the canal one of relatively small capacity, as would certainly be the case if constructed in this way, it would seem the part of wisdom and economy to build the main ship canal as here projected first. After that is finished, or decided upon, a system of inland waterways for Indiana can be planned to better advantage in relation to the ship canal.

FOR MILITARY STRATEGY.

The dominant thought in the minds of the people in urging the construction of this canal is to serve the purposes of trade. But there is another reason for building this canal which is of the highest importance from a national point of view. A glance at Figure 1 will show that when the Canadians have made their St Lawrence-Ontario canals twenty-one feet deep and perhaps, also, their Trent valley canal, and still more when they have made their Ottawa ship canal twenty-four feet deep, which they can easily do, and ought to do, and for which there is an abundant water supply at summit level, then Canada or any other power controlling her territory would have a tremendous advantage in naval operations on the Great Lakes. Even when the Erie canal in New York is made into a ship canal, the problem of defense in the Great Lakes will only be partially solved, for it will be still necessary for war ships wishing to go from Lake Erie to Lake Huron or from Lake Huron to Lake Superior to pass through the connecting rivers which form the International boundry. An alert enemy could easily make such movements impossible. If the Michigan and Erie canal here proposed were made into a ship canal war vessels could easily pass from Lake Erie to Lake Michigan and from this into Lake Huron in our own territory and without coming in contact with the foreign border. There is also an easy route for a canal from the north end of Green Bay to Lake Superior at AuTrain. This canal would need to be only 38 miles long and would be of great service to commerce as well as for military purposes. It would save 250 miles or more on every trip between Duluth or the iron or copper country and Chicago. If it were made into a ship canal, it would give safe access for war ships to Lake Superior also, and the Canadians could not match it by an independent canal on their side. While there is no present reason to build canals for military purposes, yet the Canadians are building canals which will give them or any one controlling their territory naval access to the Great Lakes and leave us absolutely helpless unless we build ship canals on our side. This canal ought ultimately to be made into a ship canal for this reason, if for no other, and having been so made, it would be much more efficient for canal barges, especially for large ones, as well as providing a channel for lake and ocean going steamers.

THE VALUE OF THIS CANAL IN " THE GRAND STRATEGY OF TRADE".

The full value of this canal to commerce is not easy to realize at the present time, because we are not familiar with the type of carrier which will almost certainly be used when our great canals are built. It is impossible to believe that when the canals are ready American inventive genius will long delay the evolution of a carrier which will give the utmost efficiency and cheapness of transportation and be perfectly adapted to the waterways. It seems certain that the cheapest possible transportation, where waterways are suited to their use, is the large canal barge without motive power—a barge carrying 3,000 to 5,000 tons or possibly even more, to be used in small fleets and towed either by a small tug or by another barge with power or else propelled by electric power drawn from a wire on the canal bank. It is not economical to carry the bulky freights in single steamships that make fast time. Speed is costly, and the more of it used, the greater the cost. Such freights are now carried to some extent in this way on the Great Lakes, because under present conditions there is no cheaper way available; there are no great canals with barge fleets specially adapted to them. If canal barges are to be made fit for towing across the open lakes, where they would be exposed to storms, they must be made a little heavier and stronger than for canal traffic alone. This would have to be done for barges that must be towed the length of Lake Erie, and would, of course, add a little to the cost and weight of the barge. But the effect of this on rates of transportation would be so small that it would not detract seriously from the advantages of the canal barge traffic.

Nevertheless the need of a continuous large-barge route without open-lake travel between the East and West may ultimately lead to the building of a barge canal along the south side of Lake Erie. From Toledo to Lorain such a canal would be easy to make at lake level near the shore. From Lorain to Buffalo it would be more difficult, but will no doubt be undertaken at some time in the future.

While barges for routes without open water would not need such strengthening, there is one important circumstance of our future commerce which will require many barges to have this strength. The coastwise coal trade is now carried on largely in motorless barges towed by tugs, and much other trade might be done in the same way. If the Erie canal and the canal here proposed were now in use as deep waterways a large traffic in barges without transfer or breaking bulk would surely be carried on between the lake region of the interior and the cities of the Atlantic coast. Such barges would need sufficient strength for marine towing, and those fitted for this trade would likewise be fit for open lake traffic. When the Atlantic and Gulf Coast canals are built this traffic will become a great thing, and the barges in this trade will need the same strength for towing on Chesapeake Bay, Long Island Sound, etc., as on Lake Erie. When the main deep waterways now planned are completed, it seems certain that the great bulk of our domestic trade in fuel and raw materials will be carried on in this way, for it would make available the cheapest possible water rates. The building of the Michigan and Erie canal, especially as a deep waterway or ship canal, will hasten that time, and when that time comes, this canal will be indispensable. Single lake or ocean steamers could not compete with this traffic, unless they were going abroad or on some course where the towed barges would not be safe or satisfactory.

Single steamers with speed of twelve to fifteen miles per hour would hardly find any advantage in using the canal so long as the Straits of Mackinac were open. But on the average the canal would be closed by ice only 50 to 55 days or about half as long as the northern straits. Unless steamers could go about seven miles per hour in the canal, they would gain no time in the canal as compared with the northern route. Such speed would require the canal to be a real ship canal with revetted banks. Seven miles an hour is the speed now used in the Suez canal. At five or six miles per hour, which ought to be possible in the proposed canal, a steamer would lose but little time and would save considerable fuel and all risk of storms on the lakes. With the canal open and the northern straits closed, the canal would be of the greatest service to single steamers, but at other times the advantage for them would be slight either way.

But it must not be forgotten that the lowest possible water rates for the east-and-west long haul cannot be attained until the Toledo, Fort Wayne and Chicago canal is built and given the depth and capacity of a ship canal. Rates on the east-and-west route cannot equal or even approach those on the Mississippi until this is done. And further, the lowest rates cannot be attained in single steamers, but only in canal barge fleets. The savings which this canal will bring by the use of barge fleets and steamers with consorts will be so great that the canal will become indispensable.

According to the latest estimates the average cost of carrying freight on the Great Lakes is .85 of a mill per ton per mile. At this rate it would cost 34 cents to carry one ton 400 miles. That is to say, this represents the possible average saving on every ton of freight between Chicago and Lake Erie ports if the proposed canal were available. For a ship carrying 2,000 tons this means a saving of $680; for one carrying 5,000 tons, $1,700; for one carrying 10,000 tons, $3,400; for one carrying 12,000 tons, $4,080. There are now about twenty-five 10,000 ton ships on the lakes and eight or more of 12,000 tons, employed chiefly in carrying iron ore, coal and grain. The ships now being built are chiefly 6,000 tons or over.

These are the savings that would be accomplished in single steamers if they could go through the proposed canal at full speed. But the speed of barge fleets and of steamers towing consorts in the open lake is about the same as that of a barge or a barge fleet in a large, deep canal. Hence, with these means of traffic the saving of time by going through the canal instead of the northern straits would be equal to the difference of distance on the two routes. In barges and consorts, therefore, the above figures represent the saving which would actually take place by the canal route. But the real saving would be still greater, because the rate would surely be less than .85 of a mill per ton-mile. For there would be smaller crews, less supplies, less fuel and less risk from storms. The rate might be expected to fall at least to .5 of a mill per ton-mile.

Coal is hauled from Cleveland to Chicago in the summer in boats of all sizes for from forty to fifty cents a ton—sometimes for less. The distance by the present water route is a little more than 750 miles The proposed canal would save 400 miles of this distance, or slightly more than half, and coal would then be hauled for half, or somewhat less than half what it is now, if carried in large canal barges. In the fall when the grain trade is on and boats are scarce it sometimes costs from $1.00 to $1.10 a ton to carry coal to Chicago.

Some idea of the value of this canal to Chicago trade may be gathered from the following figures. In 1905 the total lake tonnage entering and leaving Chicago amounted to nearly 15,000,000 tons. It is probable that three-fourths of this was bound to or from Lake Erie ports. But to avoid any over estimate we may assume that only two-thirds of it was so bound. At the average rate per ton quoted above and with open lake transportation it would cost $3,400,000 to carry 10,000,000 tons 400 miles. Of course, the saving in the case of lake and of ocean steamers would be slight if anything, because of the reduced speed which such vessels would have to take in going through the canal. But more than this will be saved when the traffic is done in barges.

When the Lakes-to-the-Gulf deep waterway is built and a network of inland waterways is constructed in the West, when the Atlantic coast canal is ready, and the Erie canal is made a deep waterway to the sea, the traffic at Chicago will be many times the figures here given. And it would certainly not be long before the saving accomplished by the Michigan and Erie canal would amount to ten or twenty millions of dollars a year, and this will much more than reimburse the people for building the proposed canal and making it large and deep.

It would be a grave mistake, however, to look upon the saving in freight charges made possible by this canal as being the sole or principal benefit which it would bring and to regard this benefit as measured by so many dollars in the pocket of each particular shipper. The benefits of the canal reach far beyond this. It would benefit all of the people. The savings arising from its use would be distributed through all the trade and business of the Middle West. It would affect directly the prosperity and welfare of all the agriculture, mining and manufactures throughout the whole region. Raw material could be brought in more cheaply and manufactures carried out more cheaply, both processes enabling the Middle West to enter seaboard and foreign markets which are now inaccessible. It is simply impossible to calculate the effects which such a stimulus would have upon life and business in the Middle West. It is not so much in the dollars and cents which can be definitely measured that the great benefit of this canal will come, as in the general and widely distributed stimulus of trade and industry that will affect all prices and give everybody a better chance at the worlds' markets and therefore a better hold upon prosperity. The states comprising the Middle West are no doubt capable of sustaining one hundred million people, or, say four times their present population. They cannot attain to their normal growth and prosperity under present conditions of transportation, and the completion of the Lakes-to-the-Gulf deep waterway, while doing much to open the gates of foreign trade to the Middle West, will not afford the relief which an effective eastward outlet will furnish. But to be effective, this outlet must be deep and as short as the best all-rail route. The normal route of transportation for European trade and for eastern seaboard trade with the Middle West is on east-and-west lines.

A CANAL FOR NATIONAL RATHER THAN LOCAL COMMERCE.

While this canal would be of incalculable benefit to

Chicago, Toledo, Fort Wayne and other cities along the line, and to Cincinnati, South Bend, Terre Haute and other cities on connecting lines, it would be a profound mistake to urge its construction on the ground of benefits to any particular place. By far the greatest value the canal could ever have would be its service to national commerce and especially in affording the cheapest possible transportation between the Middle West and the eastern seaboard. When they have examined this project carefully and weighed all its benefits and advantages against the cost of its construction all the cities along the line and its branches and, in fact, all the people of the Middle West will unite in demanding its construction. But because this canal will perform so great a service to national commerce does not by any means prevent it from being of the greatest service locally. And while these local benefits are not the first things to consider, they are nevertheless of great importance. No doubt there are special interests that will fancy themselves injured by such a canal, but such injuries are mainly fanciful, will be only temporary and the very same interests will in the end be greatly benefited. It has been said that certain interests in Chicago are opposed to such a canal having its terminus at South Chicago, and there are some that strongly oppose the construction of a canal westward from South Chicago to the Drainage canal at the Sag, on the ground that it would divert business from Chicago. It is a pity that such narrow ideas should have any lodgment in the minds of a people so justly renowned for broad, liberal and progressive views as the business men of Chicago. For no matter where the terminus of the canal is located in the Chicago district, that city will control as much of the trade as she desires and will get far greater local advantages from the canal than will any other one place. Even with Chicago's lake commerce as it is today, the people are grumbling continually in the press about the "bridge nuisance". What will they do about that when the river traffic becomes several times what it is now? It is absolutely certain that Chicago will be as glad then to have a canal from the Sag to South Chicago that will relieve the congestion of boats in the Chicago river as they are todav to have the Belt Line railroad around the outside of the city to relieve the city railroad yards of the great traffic that is passing through without stopping. But whatever Chicago wishes in this regard can be done when the canal is first built, leaving the ultimate connections and adaptations to be developed later.

The idea of this canal was in the minds of some of the business men of Chicago two or three years ago, as is shown by the following quotations from the report of the Deep Waterway Committee of the Chicago Commercial Association, 1906.

"Should a ship canal be constructed from Lake Michigan to Lake Erie, as your Committe believes it will be in the near future, it would give an all water route between the West and the seaboard, practically the same in length as that by rail. The cost of this work would not exceed $200,000,000, but it would enhance by billions of dollars the actual value of the real estate, commercial and manufacturing interests of the Great Middle West.

There does not seem to be any valid reason why a government as rich and resourceful as our own, should not expend the required amount for the benefit of the people and the internal commerce of this section of the country. It would give the Middle West an eastern waterway open for two months longer each year and remove a restriction upon it for that period during which the Straits of Mackinaw are ice bound and be of advantage to both East and West." It seems certain that a canal fourteen feet deep on the proposed route would cost little more than half of this, but, of course, cost increases rapidly with depth.

The most important carrier of the future between the West and the seaboard will not be lake or ocean ships, but *canal barges of large tonnage.* For they are much cheaper to build require smaller crews and consume much less coal per unit of tonnage than ships. This has been proven in Germany. The cheapest carriers are barges without motive power, to be towed by tugs or other power barges. The true solution of the transportation problem is in making the main waterways suited to large barges. But waterways large enough for barges of 5,000 tons or more would accommodate ships also if they choose to enter. As has been the case with both railroads and ships, the improvements of the last thirty or forty years have reduced freight rates to one-third and one-fifth of what they were respectively, so great canal barges, like those named, have not yet been used anywhere, and we may expect cheapening improvements in them as well as in railroads and ships. Improved facilities for loading and unloading will also go far to reduce and minimize the cost and delay of transfer.

NEW YORK AND THE CANADIAN CANALS.

The benefits of this canal, however, are not confined to the Middle West. New York and other seaboard cities would also be greatly benefited. If the people of New York City have any doubt of the value of this canal to them, let them study Figure 1 of this pamphlet and consider the following facts: The Canadians possess the natural, the best and by far the easiest and shortest lines of connection between the Great Lakes and the sea—the St. Lawrence canals from Montreal up to Lake Ontario and the Welland Canal from the latter to Lake Erie; the Trent valley canal, affording a remarkably short route from Chicago and Duluth through Georgian Bay and the Trent valley to east end of Lake Ontario and the head of the St. Lawrence canals. And last and best, the Ottawa river route from Georgian Bay through French river, Lake Nipissing and the Ottawa river to Montreal. This last is in truth the best of all ship canal routes from the upper lakes to the sea. This route has been surveyed and will require only about 29 miles of actual canal construction to be ready for use—so large a part of it is now in its natural state ready for navigation without improvement. Its summit level can be made at least 75 miles long, including Lake Nipissing, and there is an abundance of water supply for any capacity of ship canal that may be desired—even of thirty or forty feet depth, if need be, Of these two northern Canadian routes the writer is speaking partly from personal observation, having been over a large part of both, including their summit level reaches. The distance is 300 miles shorter from Mackinac Straits to Troy, N.Y., through the Trent canal than through Lake Erie. While this canal, with its present depth of only seven feet, is not an important factor, it might be if it were deepened. But a ship that is bound from Chicago to Europe, having reached Mackinac, would hardly come down to Lake Erie and New York City; it would take the much shorter Ottawa route directly to Montreal and the Gulf of St. Lawrence. By this route it is only twenty miles farther from Chicago to Montreal than from Chicago to Buffalo. Does New York wish western trade to take this route? Does Chicago wish it? The plain truth is that even if the Erie canal be enlarged to a ship canal, it will still be only partially potent to pull western traffic to New York. It cannot do this *until the Michigan and Erie canal is built and made of equal capacity to the Erie canal in New York state,* so as to dispense with the long detour through the northern straits. Thus the proposed canal is in effect a westward extension of the Erie canal itself, and is indispensable to its complete utility. If New York City has any earnest desire to have western commerce pass through its gates rather than through the gates of Montreal, it must have the Michigan and Erie canal with capacity equal to that of the Erie canal, and there is an ample water supply available to make it so.

The Erie canal ought to be made a ship canal, not for ships and military purposes alone, but for the much more efficient service it would then give to traffic in canal barges and barge fleets.

Some have said that New York does not want the Erie canal made into a ship canal, because trade would go directly to Chicago without stopping in New York. But this is a narrow, unworthy view of the matter. The prosperity of New York, so far as it is dependent on the Middle West, does not rest on New York's ability and opportunity to stop and levy tribute upon all the commerce to and from that section. New York will derive far greater benefits from the general growth and prosperity of the Middle West and the resulting increase in its wealth and activity in trade than it will from any system of tribute.

The following facts should also be of some interest to New York people. From Chicago to New Orleans by the route of the proposed deep waterway (canal from Chicago to St. Louis and also from St. Louis to Cairo; Mississippi river by its winding course to New Orleans) is a distance of a little more than 1,500 miles. It is 96 miles farther to the Gulf at the jetties, but New Orleans is the port. By the present water route from Chicago to New York City it is a little more than 1,400 miles. The proposed canal will cut 400 miles off the last figure and make the distance from New York to Chicago about 1,000 miles. Will New York throw away this advantage? Does not the Middle West need this canal for that part of its great east-and-west trade which cannot be profitably diverted to the Mississippi and the Gulf? In truth New York ought to be as enthusiastic for the construction of the Michigan and Erie canal as the Middle West is for the enlargement of the Erie canal in New York state. Any device that will bring the Middle West 400 miles nearer to New York City and Europe is surely a thing worthy of consideration.

The people of Fort Wayne who originated and are strongly pushing the project for this canal are not basing all of their enthusiasm on the benefits that would accrue to Fort Wayne. They believe the canal to be a necessity for national commerce, and after the Mississippi river and the Erie canal in New York state, they believe it to be the most important canal yet suggested for national trade. As to choice of the route they believe that the best and only feasible route for a great deep waterway or ship canal passes through their city, but they will not insist upon that. They are willing to abide by the desision of competent engineers after a careful survey. If it is found that a better route for the canal would pass over the hill ten or twenty or forty miles north of Fort Wayne, they are willing to abide by the decision. In that event Fort Wayne can easily establish connection with the canal by a branch line. What the people along the proposed canal route are asking for now is a careful survey of the line by the national government.

This pamphlet is published by the Toledo, Fort Wayne and Chicago Deep Waterway Association of Fort Wayne, Indiana. Its officers are Hon. Perry A. Randall, president; Hon. T. J. Logan, secretary; with a committee of five hundred and an active membership of more than a thousand. This organization is not for a day, but is permanent and intends to use every honorable available resource to promote the interests of the proposed canal. The general subject of inland waterways and deep channels to the seaboard is one of incalculable importance to the American people, but could not be given space for adequate treatment here. It is admirably discussed in addresses by Mr. S.A. Thompson, field secretary of the National Rivers and Harbors Congress, to whom the writer is indebted for much valuable information.

Anyone wishing a copy of this pamphlet can obtain the same by applying to T. J. Logan, secretary of the Toledo, Fort Wayne and Chicago Deep Waterway Association, Fort Wayne, Ind.

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